

Assembly Test Chips Give Inside Information About Conditions on the Circuit Board

You can torture a computer chip, but you can't make it confess its faults. That's a problem, because the packaging and assembly process, as well as what happens later during the chip's life, can be torturous. The chip may work fine for a while, then — when things get too tough — simply die.

But if a normal chip doesn't tell any tales, there's another way: Put a more loose-lipped one through the same process and see what it reveals. Sandians in the Microelectronics Development Lab are making this possible through the development of increasingly elaborate "assembly test chips."

These chips can reveal the origin of problems even after packaging and assembly has made the microcircuits inaccessible to direct observation. They may benefit the American microelectronics industry if (as is planned) the technology is transferred for commercial use.

Packaging and assembly — which takes place after the individual chips are cut from the "wafer"

An operational chip may just stop working without warning.

on which they're fabricated — includes mounting the chip on a suitable substrate (usually metal or ceramic), making electrical connections, attaching a covering, and finally encapsulating or sealing the package for protection. All in all, it's a process as

critical as the initial design and fabrication of a semiconductor component.

When Chips Are Down ...

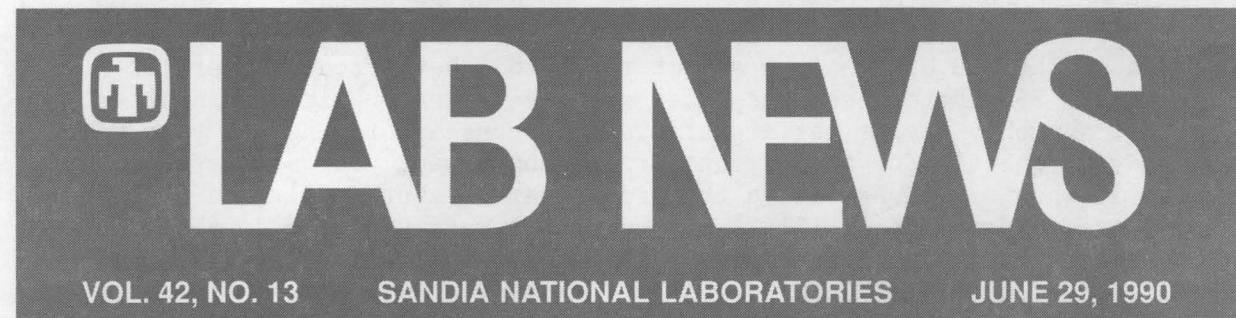
"In a long-lived electronic system," says Dave Palmer, Supervisor of Packaging and Interconnec-

tion Development Div. 2134, where the assembly test chip was developed, "many thermal, mechanical, and chemical-outgassing threats develop over time. Half the resulting failures are packaging-related, and they occur without warning."

(Continued on Page Ten)



JIM SWEET (2134, center), designer of the assembly test chip, watches colleagues Dave Peterson and Melanie Tuck (both 2134) put chips into a highly accelerated stress-test chamber, where the chips will be subjected to temperature and humidity testing to evaluate the moisture resistance of the packaging.



US and Soviet Flags Get Together on Navajo Rug

When Gary Ahasteen (9231) visited the Soviet Union this spring, he presented an unusual gift — a hand-woven Navajo rug — to the Space Research Institute of the USSR Academy of Sciences. The rug is now on display at the Academy's museum in Moscow.

Gary's mother, Mary, spent about a month last winter making the fine wool rug, which depicts US and Soviet flags — in correct colors — joined by a border to symbolize growing friendship and coop-

eration between the two nations. Mary has been weaving rugs ever since she was a child, Gary says. She and his father, Jim, live in Teesto, Ariz.

Gary and other Sandians were among a visiting US delegation that's cooperating in an international space project — Spectrum-X-Gamma. The US and other nations are designing new x-ray measuring instruments to go on a very large Soviet satellite that's scheduled to be launched in a few years.



GARY AHASTEEN (9231) and his parents hold a Navajo rug (woven by his mother) that's now on display at the USSR Academy of Sciences Museum in Moscow.

"We want to fix problems — not create them by being reckless."

are actually guard rails," says Barrier Buster Chairman Tom Cannon (2850). "We're dead serious about removing barriers as quickly as possible, but we're also proceeding cautiously to ensure that we don't meddle with essential policies, procedures, and rules.

"Some are actually sound business practices or rules to ensure that we don't compromise security," he continues. "We want to fix problems — not create them by being reckless."

A List of Candidate Issues

To start the process in motion, each team member was asked to conduct an informal poll of five to ten individuals in his or her organization (both vertically and horizontally) to get a list of

(Continued on Page Eight)

Quality Directorate Formed — See Page 4

This & That

Tie One Off — A little empowerment — like a little knowledge — may be dangerous in the wrong hands. Well, I'm feeling particularly empowered this week, so I'm telling Sandians who wear neckties during these hot summer days that they're not required. If Al Narath doesn't feel the need to "tie one on" every work day — and he doesn't — then neither should the rest of us male types. While I'm experiencing this surge of empowerment (I think it's going to my head), I'll take it a step further and say that if your colleague or boss wears a tie on a 100-degree day, empower yourself — point and laugh, or reach out and untie it.

* * *

False Alarm — I promised my colleague and former boss, Nigel Hey (3161), that I wouldn't mention to anyone that he accidentally set off the fire alarm recently in Bldg. 800 with his cellular "Dick Tracy" phone. I lied.

* * *

Probably Here, Too — Bruce Hawkinson (3153) saw this sign posted in an auto repair shop recently when he was visiting family in the "Land of Oz" (Kansas):

CAUTION
If you believe that
OSHA
is a small town in Wisconsin,
you're in trouble here.
* * *

Names Needed for Responses — Following up on the article last issue about the revamped Feedback and Employee Suggestion system: We received a couple of good written suggestions from a Sandian who asked for a response. Unfortunately, that person didn't include his/her name. Our space and budget limitations mean that we can't publish all Feedback items in the LAB NEWS, so we select those that have broad, general interest. For the others, responses go only to the submitter. In other words, the only way to get a guaranteed response is to include your name with your question or suggestion. If you don't want your name associated with it when we forward it to the proper person, but still need a response, Janet Walerow (3162) can tell you exactly how to do that and otherwise provide guidance about submitting questions and suggestions. Call Janet on 4-7841.

* * *

Strange Correspondence — A letter recently arrived at Measurement Standards Dept. 7240. It was addressed to Boritories Sandia Natl La, and to no particular individual. Of course, "Personal" was typed and underlined on the envelope.

* * *

Wild Wildlife Writing — Two sentences caught my eye in a recent news release about snakes in New Mexico:

"Some [snakes] even eat insects, like the pesky mosquito that everyone dislikes." If everyone dislikes that little sucker, we can only hope a snake eats it.

". . . if a snake does bite you, it is important to properly care for it." Don't know about you, but if a snake bites me, I'm not about to care for it.

•LP

Mr. Beckner Goes To Washington

Everet Beckner, VP of Defense Programs 5000, has accepted a temporary assignment at DOE Headquarters as Special Science Advisor to the Secretary on Weapon Activities. He begins the six-month assignment July 2.



EVERET BECKNER (5000)

"I'll be working closely with DOE officials — including Secretary James Watkins, Under Secretary John Tuck, the Assistant Secretary for Defense

Programs, and others — on a variety of weapon-related issues," says Everett.

"I'm not going to Washington with any specific agenda, but I expect to get involved in several high-priority matters at DOE these days — nuclear weapon safety and ES&H concerns within the weapon complex, for example. I may also be interfacing with some of the negotiators on the START treaty."

Everet replaces George Miller of Lawrence Livermore National Lab in this position. While Everet's gone, Heinz Schmitt (5100) will be Acting VP of Defense Programs 5000, and Gary Beeler (5130) will be Acting Director of Weapon Development 5100.

Welcome

Albuquerque — Michael Bartram (1126), Cheryl Desjardins (21-1), Michael Hagengruber (2625), Paul Helmick (6423), Linda Logan-Condon (3523), John Mounho (122), James Payne (9231), Anthony Shay (7414); *Other New Mexico* — Virgil Anderson, Jr. (5131), Joseph Polito (412).

Elsewhere: Arizona — Charles Brady (5143); *California* — Dale Cooper (9144); *Colorado* — Stephen Wehrend (5173); *Illinois* — Patsy John (7821); *Kansas* — Wallace Bow (9131); *Nebraska* — Martin Reuss (5175); *Virginia* — John Meinhart (9000); *Wyoming* — Timothy Estes (7413).



LAB NEWS

Published Fortnightly on Fridays
SANDIA NATIONAL LABORATORIES
An Equal Opportunity Employer

ALBUQUERQUE, NEW MEXICO 87185-5800
LIVERMORE, CALIFORNIA 94550
TONOPAH, NEVADA
NEVADA TEST SITE
AMARILLO, TEXAS

Sandia National Laboratories, a prime contractor to the US Department of Energy, is operated by Sandia Corporation, a subsidiary of American Telephone and Telegraph Co.

LARRY PERRINE, Editor (505/844-1053)
PHYLLIS WILSON, Assistant Editor (844-7842)
CHARLES SHIRLEY, Writer (846-5542)
LINDA DORAN, Writer (846-6888)
RANDY MONTOYA, Photographer (844-5605)
MARK POULSEN, Photographer (844-5605)
JANET WALEROW, Editorial Assistant (844-7841)
TABITHA JEANTETTE, Assistant
BARRY SCHRADER, Livermore Reporter
(415/294-2447; FTS 234-2447)



THELMA FOSTER, secretary to President Al Narath, recently looked over the view of the library mall with the boss. After 29 years at Sandia, Thelma has decided to retire; today's her last day at the Labs.



Directorate Challenge 1990

AND THEY'RE OFF as the starter gives the signal.



AWARDS PRESENTATION: (from left) race co-chair Dan Dawson (8243), Brian Brunner (contractor), Carol Caldwell (8541), Jackie Chen (8244), and co-chair Barry Bolden (8161).

Supervisory Appointment

HOWARD HIRANO to Supervisor of Computational Development Div. I 8445.

Howard joined Sandia at Livermore in December 1977, working in Engineering Technology

Dept. 8440 as a mechanical engineer. His assignments included W76 and W79 components. Following that, he worked in the W87 project division for three years, then transferred back to 8440 and worked on the W76 and advanced development programs. Recently, Howard has been a

leader in the Engineering Technology Department Quality Initiative.

He holds a bachelor's in mechanical engineering from the University of Colorado and a master's in the same field from UC Berkeley. Before going to Berkeley, he worked at Westinghouse Hanford for two years.

Howard and his wife, Christine Yang (8237), have a daughter and live in Dublin. Howard's outside interests include jogging, reading, photography, and outdoor family activities.

Sympathy

To Renee Haynes (8531) on the death of her father in Castro Valley, June 12.



In this year's Directorate Challenge, Brian Brunner (contractor) edged out perennial winner Jim Reitz (8451). In the women's division, Carol Caldwell (8541) broke her previous course record with a time of 7:36, five seconds faster than last year. Coming in second through fifth were Jackie Chen (8244), Ellen Meeks (8245), Sally Raubfogel (8133), and Joan Funkhouser (8272). In the men's division,

Brian had a 6:44 and Jim a 6:45; others in the top five were Bill Wilson (8210), Rich Larson (8244), and Tim Sheppard (8311). There were 204 participants this year. The 8200 directorate won the participation award, with 32 percent of its people entering. The 8500 directorate was next with 19 percent, and 8100 was third with 15 percent. The only centipede entry this year was the Tiger Team ES&H crew from 8230.



IN A PHOTO FINISH, newcomer Brian Brunner (contractor) outpaces Jim Reitz (8451). Brian is in front, with Jim's heel and arm just visible next to him.



SANDIA'S BOARD OF DIRECTORS met recently at Livermore. They toured the X-ray Plasma Source Lab in Bldg. 916, shown here, and other facilities. In front, from left, are Bob Kestenbaum (4000); Board member Solomon Buchsbaum, Senior Vice-President of Bell Labs; Board member Morris Tanenbaum, Vice-Chairman and Chief Financial Officer of AT&T; and Venky Narayananamurti (1000). In back, from left, are Peter Mattern (8300); Sandia President Al Narath; Board member John Zeglis, Senior Vice-President/General Counsel of AT&T; Rick Freeman, AT&T project manager in a joint effort with Div. 8342; Glenn Kubiak; Rick Stulen (both 8342); John Crawford (8000); and Gerry Yonas (400). The Board met Livermore employees during an outdoor reception on the Bldg. 912 patio.

Eliminating Impediments, Measuring Progress

Sandia Will Test Itself Against the Best

Sandia's Strategic Plan says that the Labs intends to become a national leader in quality and quality progress. That's no easy task, but establishing a new directorate — Quality Improvement 7300 — shows how committed Sandia's management is to the goal, says Larry Bertholf, Director of the new organization. "We're just getting started on our journey to national leadership," he says, "and we've got to have commitment at all levels."

Larry is particularly concerned about the quality implications of management practices. He gives an example: Executives in a US auto company decided that quality could be improved by establishing long-term relationships with suppliers. Months later, though, there were no more long-term relationships than before. The problem, it turned out,

"Quality improvement means difficult changes in management practice."

was a company rule: For any supplier contract lasting more than a year, two additional levels of management approval were required. The solution was to change a single word — now two additional levels of approval are required for any supplier relationship lasting *less* than a year.

This, says Larry, is an example of a company policy that was impeding quality and had to be detected and altered. "Most quality experts believe that about 80 percent of difficulties with quality in the US are management-related. The ways we do things, the policies we make, can help us or hurt us."

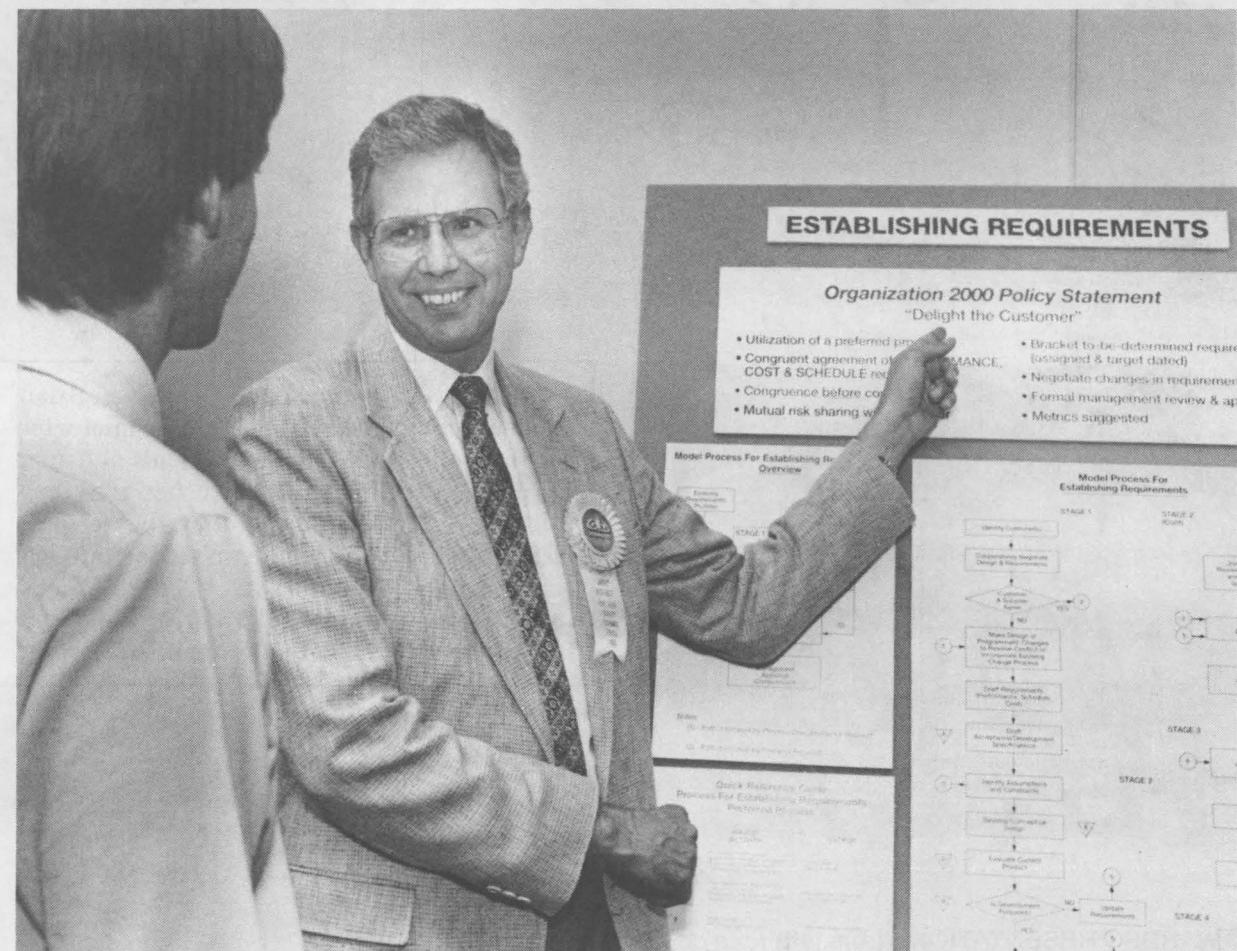
"Undoubtedly, we have some counter-quality policies," he continues, "though we don't yet recognize which ones. We have to find them and change them. It won't be comfortable for management, because quality improvement means difficult changes in management practice. It will take thought, work, cooperation, and sometimes pain."

Benchmarking Best Practices

Larry's directorate consolidates existing quality-related functions and adds a new department: Corporate Quality 7310. Within that department will be responsibility for supporting two new aspects of the Labs' quality initiative: corporate self-assessment and best-practices benchmarking.

"Best-practices benchmarking may be unfamiliar to a lot of Sandians," says Larry, "but it's really a great technique — it's dynamite! You take an area of your company that has a function a lot of other companies also carry out, and you find out which company is the best at that function and what it does."

"You also measure how well you're doing relative to the best. Then you start trying to get to that level of quality. Of course, the best company will be improving at the same time, so you're pursuing a benchmark of quality that moves out. As you



LARRY BERTHOLF, recently named Director of Quality Improvement 7300, discusses processes for meeting quality goals with a visitor to the Org. 2000 Quality Exchange Fiesta, held last week.

pursue it, you get better and better."

President Al Narath says, "Competitive benchmarking is crucial for attaining quality. It gives us a world-class target to shoot at, and it therefore provides a necessary incentive for superior performance. Our goal is to be a leader in quality. Ultimately, benchmarking is necessary to prove that we have become a leader and that we are improving fast enough to remain a leader."

As an example of a company that uses benchmarking, Larry mentions Xerox, a winner of the 1989 Malcolm Baldrige National Quality Award (see box on next page) — and adds that in shipping and receiving, Xerox's benchmark is L. L. Bean, the Maine-based supplier of outdoor products.

Must Measure Improvement

Though the obvious starting point is with functions common to most businesses — shipping and receiving, purchasing, or administrative computing are examples — those aren't the limit. "We can apply benchmarking to many areas of Sandia," Larry says. "Here's one that may draw some attention: Why not benchmark management? Let's find out who is the best at managing R&D labs, see what they do, and ask ourselves why we aren't doing the same."

To make measurable improvements, of course,

there must be measurement. Larry cites another US company — Motorola, a 1988 Baldrige Award winner. "According to a recent article," he says, "Motorola reduced its defect rate by a factor of 10 in the past two years and expects to reduce it by a factor of 100 in the next two. At Sandia, we have to have the tools, the metrics, that will help us measure our performance over time. Then we can demonstrate that we're improving and understand why, so we can keep on doing it."

Supplying those tools is another responsibility of the new department. "Paul Longmire has transferred from another department to manage this one," says Larry. "He has experience and a good reputation in large projects, particularly weapon projects. He's been in the trenches. He's been a leader in the Org. 2000 quality movement that Glen Cheney [VP-2000] initiated. You can be sure that the quality tools and techniques coming out of his department will reflect that experience."

One purpose of quality metrics is to help in a program of corporate self-assessment (see "Stakes Can Be High When Quality Action Teams Go to Work"). This is something to be done at the level of processes, of projects, of functions, of organizations, and of the Labs as a whole.

Self-Assessment Is Vital

"Self-assessment is a vital aspect of quality improvement," says Lee Bray (Executive VP-30). "We need to measure our progress for ourselves and demonstrate to our customers — both internal and external — that we offer the best possible per-

Reducing waste by improving quality is like having more resources.

formance, on schedule and at negotiated bid prices. That's what this process will enable."

"In developing a quality policy and plan for the Labs," says Larry, "we're integrating features for common practice, so that all organizations have quality plans with similar elements. For instance, eight Quality Improvement Policy elements will give us consistency — and, because they're similar to those used in judging for the Baldrige Award,

(Continued on Next Page)

Stakes Can Be High When Quality Action Teams Go to Work

Sandians are becoming aware of quality action teams — QATs — as part of the Labs' quality initiative, but they may not be aware of the magnitude of changes that can come about through QATs. A case in point, says Larry Bertholf (7300), is Sandia's self-assessment and performance improvement process.

"There might be a tendency to associate QATs with narrow problems, such as bolt-holes that are out of tolerance," says Larry, "but teams also deal with matters that affect Sandia much more broadly. A QAT consisting of people at levels from Supervisor to Executive Vice-

President developed a new self-assessment and performance improvement process that's going to have a major effect throughout the Labs.

"From the team's work on self-assessment came the establishment of the Quality Improvement Directorate [7300], which is a highly visible change in our structure. Also coming from this team is a new process that DOE will use to evaluate our performance as a national lab.

"So to anyone who gets a chance to be part of a quality action team, I would say jump at the chance — you might have a fundamental influence on the future of Sandia."

'We're All in This Together'

'Upward Feedback' Begins Next Month

Traditionally, performance appraisals — at Sandia and elsewhere — often have been perceived as a one-way street. Feedback seems to flow in one direction. Bosses tell subordinates how well they're doing on the job, how they could be more effective in their work, what are perceived as their strengths and weaknesses.

The one-way street at Sandia is about to become two-way; Phase I of a program called "Upward Feedback" will be launched next month. All

"People get a better handle on how they're seen by those who work for them."

members of Large Staff (Directors through the President) will receive anonymous feedback from subordinates one and two levels below them.

If Phase I successfully fulfills the program's objectives, Upward Feedback will soon be expanded to include all employees — supervisors and nonsupervisors — either as feedback receivers or providers, or both.

Why implement such a program? In a recent memo to Large Staff, President Al Narath put it this way: "As we seek to implement our vision for the 1990s as expressed in the Strategic Plan, it is essential that Large Staff be an effective leadership group. We must be models of the new culture. Improving our leadership and effectiveness is, in part, achieved by each of us understanding how we are perceived by our subordinates."

A growing number of managers at companies around the country (including AT&T) are recognizing that upward feedback, if used appropriately, can spur positive changes — in productivity, in better understanding between people who work together every day, in the overall communications process.

Unfreezing and Refreezing

In a recent article in *Training* magazine, Chris Lee, managing editor of the publication, calls subordinate feedback "a way to put into action Kurt

(Continued from Preceding Page)

will let us adopt some of the best practices in the nation as we learn about them."

Emphasis on self-assessment doesn't mean there won't be audits from outside Sandia. In areas that involve significant risk or environmental impact — such as nuclear weapons — independent audits will continue.

But that doesn't reduce individual initiative, Larry points out. "Empowered people are empowered to continuously improve the process that they're responsible for," says Larry. "They aren't empowered to meddle with other people's pro-

"Quality isn't simple, and quality certainly isn't just another job."

cesses — otherwise, the potential for chaos is immense. At the same time, we're all free — and encouraged — to offer comments and suggestions where we think improvement is possible."

There's both a payoff and a cost for quality. Everybody wants more resources, and estimates of waste caused by having to re-do jobs — one's own or someone else's — range from 20 percent to 40 percent for US companies. Significantly improving quality could have the same effect as getting more resources.

"That's an untapped, bubbling well!" says Larry. "But we can't draw from it instantaneously.

Lewin's three-phase theory of change: unfreezing, moving, and refreezing. Managers who see themselves as terrific delegators and are shown that their subordinates see them as perfectionistic power mongers tend to 'unfreeze.' In other words, they become more willing to make changes in ingrained . . . behavior [and refreeze as they try out new, more positive behaviors]."

"The real value of Upward Feedback is that it lets people get a better handle on how they're seen by those who work for them," says Ralph Bonner, Director of Human Resources 3500. "If you're receiving feedback, the idea is to look at what your subordinates have to say, and see if those ideas jibe with the way you see yourself. Sometimes they will, sometimes they won't — we don't always see ourselves as others see us!"

Upward Feedback questionnaires will be sent to all people one level below the person receiving feedback and to all skip-level (two levels below) people. VPs will receive feedback from directors and department managers, and directors will receive feedback from department managers

"A primary goal of Upward Feedback is to lower communication barriers, whether real or imagined, within groups."

and division supervisors. The questionnaire — designed by the Upward Feedback Committee, formed earlier this year and chaired by Ralph — is a set of straightforward statements rating the boss on behavior as specific as "Admits it when he/she is wrong."

Anonymity and Confidentiality

To maintain anonymity of feedback providers, summaries of questionnaire responses will be prepared by an outside consultant. Upward Feedback summaries, given in a sealed envelope to the person receiving feedback, will list his or her 10 highest-rated and 10 lowest-rated behaviors and average ratings for behaviors in selected value cat-

There's an up-front cost. If we approach it team-fashion, though, improving first one area, then another, then another, we won't pay the whole cost at once. At the same time, each of us can start to make improvements to our own processes, in whatever ways we can find or invent. That's already an attitude in a number of places in the Labs, and it should be encouraged.

"Quality isn't simple," Larry concludes, "and quality certainly isn't just another job that's being dumped on us. We're making a call — and as an organization will be providing the tools — for everyone to do his or her job differently and more effectively." ●CS

The Malcolm Baldrige National Quality Award

Congress established the Malcolm Baldrige National Quality Award in 1987 in memory of the late Secretary of Commerce. The first winners, for 1988, were Motorola, Inc.; the commercial nuclear fuel division of Westinghouse Electric Corp.; and Globe Metallurgical Inc. Winners for 1989 were Xerox Corp. and Milliken & Co. Competitors for the award — which can be given in manufacturing, service, and small-business categories — undergo demanding analyses and inspections by teams of judges.

egories — integrity, leadership, respect for the individual, and communication ability, for example. No one other than the feedback recipient gets a copy of this report, Ralph emphasizes.

The process doesn't stop when the person receives the feedback summaries; that's just the beginning. Those receiving feedback get together with a group of their peers at meetings where trained leaders (Sandians nominated by their VPs), using generic examples, help them interpret their feedback summaries and give them a chance to discuss the results with others at the sessions.

Mapping Out Changes

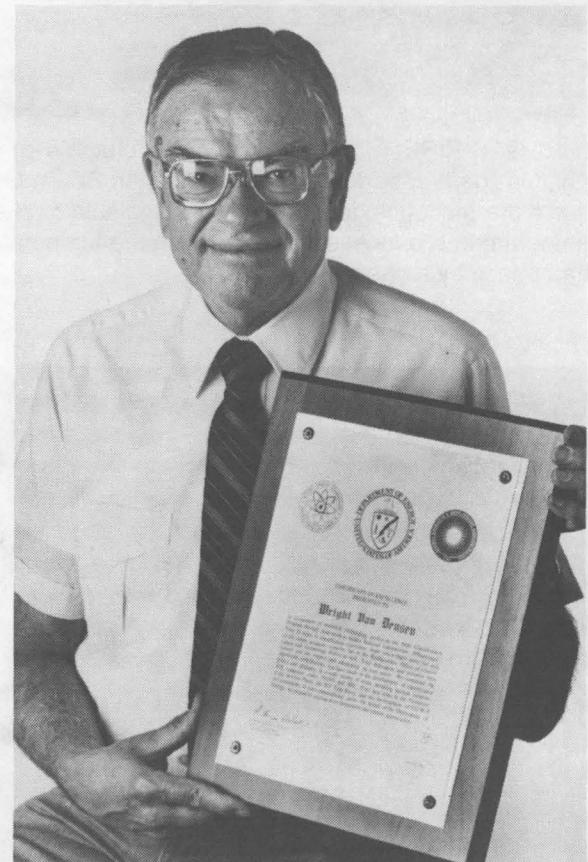
Based on summary results, managers are encouraged to develop an action plan to map out changes in the way they operate, with the goal of improving organizational effectiveness. Then comes "the heart of the program," according to Ralph — sharing the plan with their subordinates.

"Those meetings to talk about action plans are really Upward Feedback's reason for being," notes Ralph. "Once you open up a dialogue identifying strengths, concerns, and areas for improvement, a 'we're-all-in-this-together' kind of spirit is likely to appear and, with it, improved productivity and effectiveness."

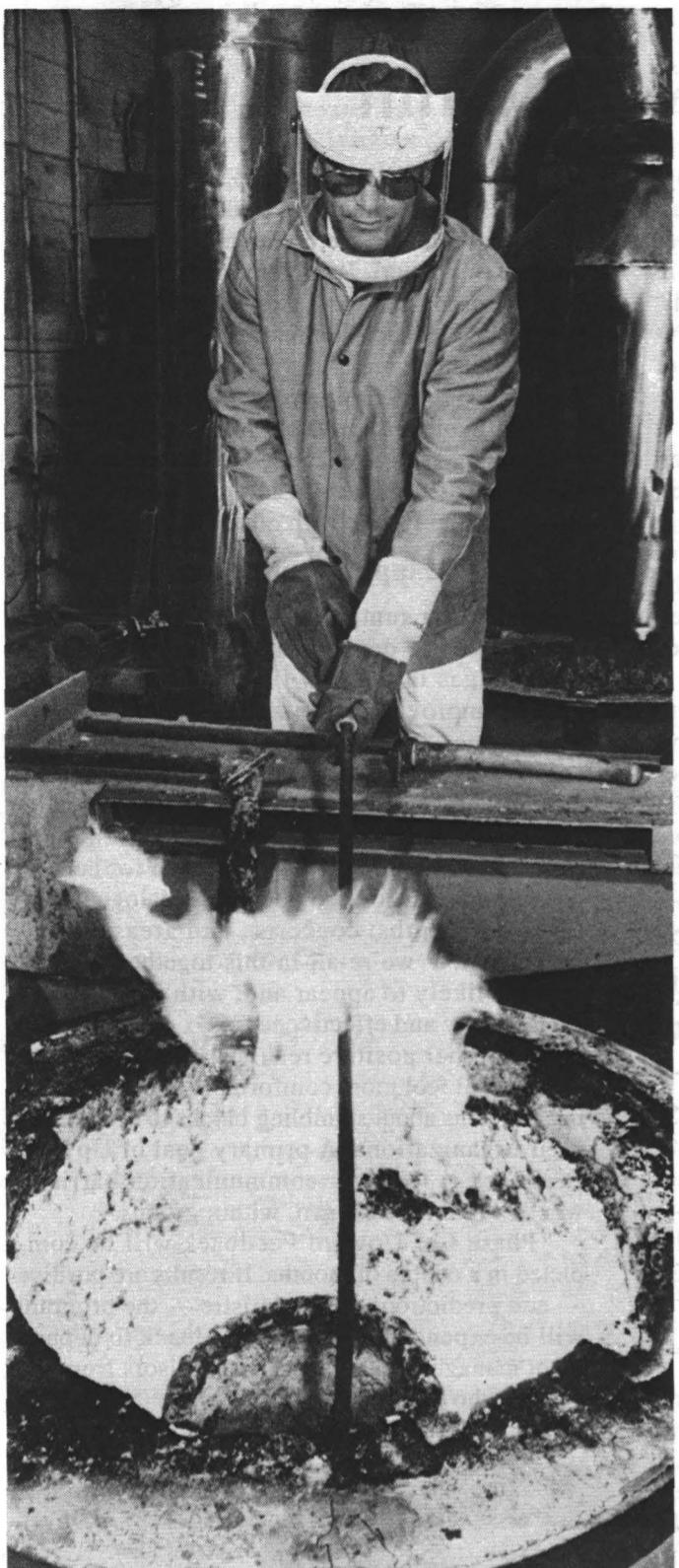
"Another positive result, it's hoped, is that people will feel more comfortable about expressing concerns about stumbling blocks to progress in their organizations. A primary goal of Upward Feedback is to lower communication barriers, whether real or imagined, within groups."

Phase I of Upward Feedback will be completed in a couple of months. If results are positive — and predictions are optimistic — the program will be expanded to provide feedback to department managers and division supervisors from the people who work for them.

●PW



WRIGHT VAN DEUSEN (ret.) recently received the Classification Award of Excellence from the DOE Headquarters Office of Classification and Technology Policy. He was cited for "significant contributions in the development of classification policy and guidance in a variety of areas, including nuclear weapons, ICF [Inertial Confinement Fusion], computer codes, NATO, and SDI." Wright, a former member of Classification and Sensitive Information Review Dept. 3180, retired last year after 29 years of service.



THIS GAS-FIRED furnace makes the crucible of molten metal inside it appear small, as tradesman Edwin Gallegos dips a thermocouple into the molten aluminum to check the temperature. His face is protected from the temperatures of the furnace by a special shield.



WAYNE CYRUS examines an aluminum alloy casting that will be used for a mobile camera base to be mounted on a trailer at the Tonopah Test Range in Nevada.

Tradesman's Work Is Hot Stuff

Whether it's weapon casings, nose cones, or pusher castings for Sandia's rocket sled, hardware produced for weapon research and other scientific endeavors has to be tough enough to withstand collisions, explosions, intense friction, and heat.

Often, products such as these are fabricated right here at Sandia, by workers who are almost as tough as the products they manufacture. In Sandia's foundry, tradesmen spend their days melting and pouring searing hot aluminum, copper, and lead into custom-made molds.

The yellow-hot liquids can attain temperatures of 1500°F or more. When the foundry workers are finished, they send the metal castings to a group of tradesmen who heat-treat the metal, subjecting it to yet another piping hot furnace and then quenching it in oil, hot water, or cold water, to give the particular alloy the properties it requires.

Still another group makes patterns and molds of all shapes and sizes, cutting and fitting pieces of wood together by hand. One recent order had journeyman patternmaker Michael Clough cutting, gluing, and sanding long planks of wood for a unique acoustic horn to be used in a noise dissipation experiment. The mold is to be sent to an outside business, where workers will cover it with fiberglass sheets and resin, which will harden in the air to form the final product. Patternmakers also make wooden patterns that are used to shape molds of sand for casting molten metals.



Most of the metals cast at Sandia's Foundry, Pattern, and Heat Treating Div. 7473-5 are aluminum or copper alloys. Steel is currently melted at Dept. 1830's Area III facility. Aluminum alloys made at Sandia usually come in three varieties — one variety is made of seven percent magnesium, another is seven percent zinc, and a third is seven percent silicon. Copper alloys include bronze and brass. The section accepts work orders from other government agencies as well as Sandia.

Until recently, Div. 7473-5 was headed by Section Supervisor Wayne Cyrus; the new supervisor is Jim Maroone. A total of six workers handle all of the melting, heat treating, and patternmaking for the section.

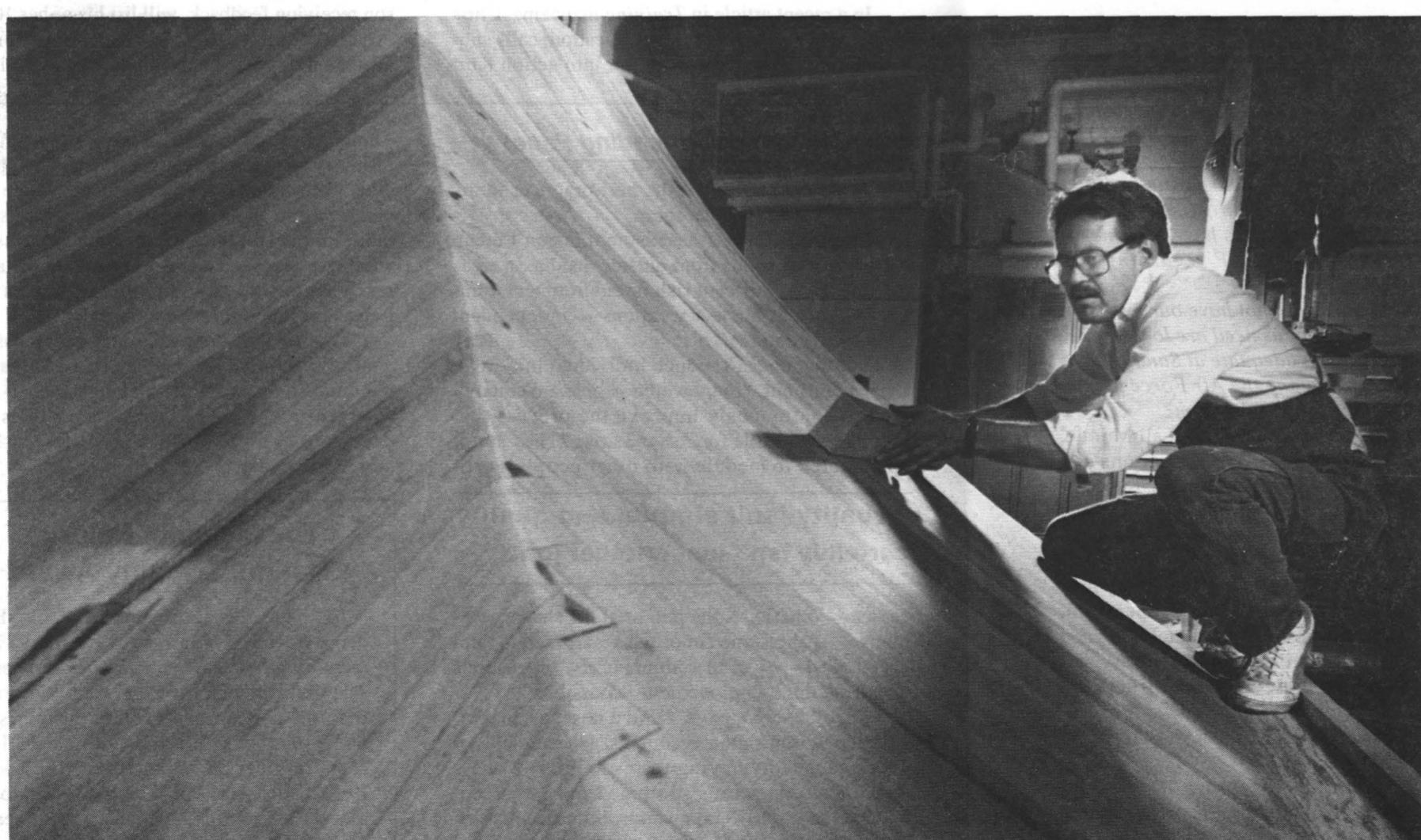
LAB NEWS photographer Randy Montoya paid a visit to the foundry to get a closer look at these workers whose jobs in some ways, other than

undergoing some safety improvements, have not changed a whole lot since the dawn of the Industrial Revolution. Today, as in the past, they still pour molten metals from heavy crucibles into molds to cast strong but ductile materials that take an incredible beating when they are put to use.

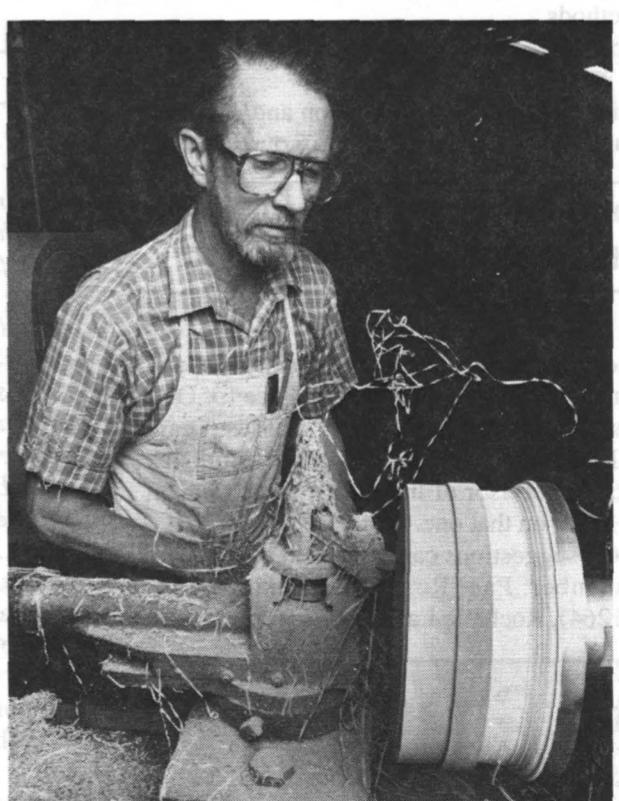
The workers themselves take a bit of a beating, too — sissies need not apply — donning heavy face masks, safety glasses, gloves, and protective clothing inside rooms that are already sweltering with the heat of not just one, but several roaring furnaces. The folks pictured all work in Div. 7473-5. •LD



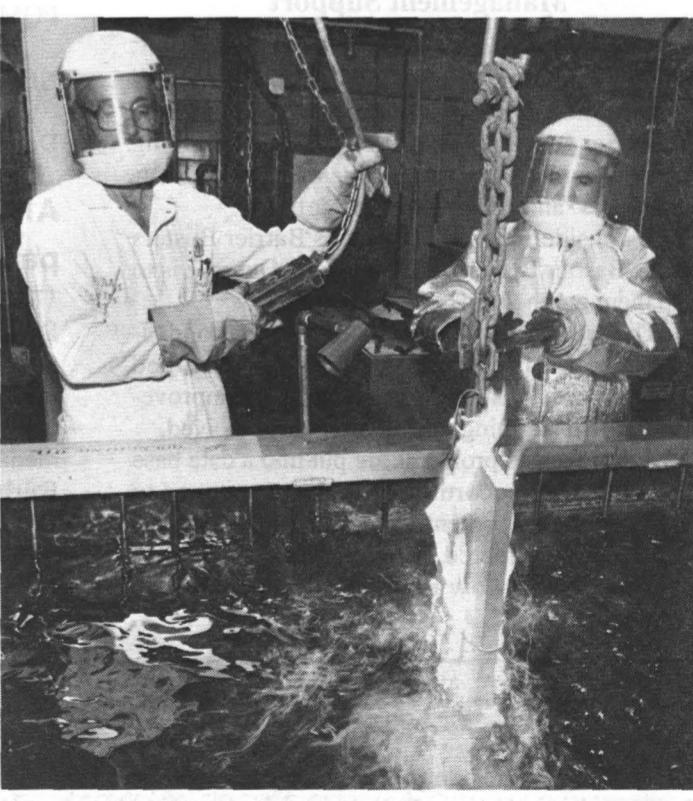
STANDING BACK a respectable distance, tradesman Gary Gallegos guides a system of bars and cranes to tip a crucible of molten aluminum over a waiting ingot mold of steel. The aluminum ingots are stored for future use.



MICHAEL CLOUGH, a journeyman patternmaker in the pattern shop, puts the final touches to a mahogany mold with a three-foot-long sander. The mold will be used to shape an acoustical horn for use in a noise dissipation study. The 18-foot-high structure is part of a three-piece mold being cut, fitted, sanded, and painted at Sandia before being sent to an outside firm to be covered with fiberglass to make the final product.



PLASTIC BOARD, used for making models and patterns, is trimmed on a lathe by patternmaker Bruce Higgins. The wiry string flying off the surface is a shaving of plastic taken from the rim of a shipping container model.



HOT METAL takes a refreshing dip in oil — cool at a mere 120°F, compared to the 1550° temperature of the sizzling slab at the end of the crane. Heat-treating the metal are tradesmen Richard Bryant, left, and Jose Salazar, who have hooked the slab to a crane and lifted it out of a furnace where the metal is heated in a fluidized bed of sand.



'We're Looking for Good Ideas'

Sandia Recognition/Reward System Being Reviewed

How can Sandia better recognize and reward employee contributions — individual and team contributions? What's needed at the Labs to encourage employees to support the Sandia Strategic Plan?

The answers won't come from "on high" but from within — from Sandians themselves, says Danielle (Danny) Brown (3590), who's leading the Rewards and Recognition Project chartered by the Sandia Management Council.

Danny says the first-phase goal is to develop and implement "tools" to better recognize and reward individual and team performance and to train supervisors in their use by March 1991. The tools will be incorporated into the performance review system. A longer-term goal is to develop a comprehensive performance management process that better motivates and encourages employees.

Survey and Focus Groups

A questionnaire seeking related ideas was recently completed by 350 randomly selected Sandians — nonsupervisory and supervisory. About 90 other employees have been invited to participate in "focus groups" to generate and discuss ideas.

The four-page questionnaire focuses on the current performance and compensation system and how satisfied employees are with it. It covers base pay, non-base pay, benefits, the performance review system, Individual Performance Awards,

Sandia Awards for Excellence, and Special Recognition Awards.

"We're trying to find out just how important these items are in motivating and recognizing Sandians — what really makes us feel good about ourselves and our jobs, what makes us look forward to coming to work, and what makes us want to do our very best," explains Danny. "Maybe we don't have

The answers won't come from "on high" but from within — from Sandians themselves.

the right combination of things to do this as well as we could. Maybe we need more or better ways. That's what this whole effort is really about — to find out if there are better ways and then get them into place."

Danny emphasizes that all Sandians with ideas can and should get involved, even if they weren't selected to complete a questionnaire or participate in a focus group.

"Very simply, we're looking for good ideas to explore, and we want every Sandian who has one to get in touch," Danny says. "Call me on 845-8238 or contact one of the Recognition and Rewards Project team members [listed below] and we'll talk about how you can participate."

Although the answers won't come from upper management, plenty of support is. Executive VPs Orval Jones (20) and Lee Bray (30) and VP Glen Cheney (2000) comprise the project advisory committee. "They've made it clear — they want the maximum possible input from employees," emphasizes Danny.

Looking at Similar Firms, Too

The project team isn't looking internally only for ideas. Team members are studying what outside firms similar to Sandia are doing that really works — looking for innovative practices that industry and public groups use that might also work here.

Sandians who'd like to provide ideas or participate otherwise can contact Danny or any of the following team members: Georgia Rivera-Gronager (113), 4-4449; Trisha Arredondo (113), 4-4996; Chris Madigan (3151), 6-8753; Julia Gabaldon (3511), 4-6281; Cathleen Hutchison (3523), 4-6736; Harriet Morgan (3533), 4-3650; Al Villareal (3533), 4-8976; B. J. Jones (3545), 6-4541; Dick Shepardson (3550), 5-8075; Bellinda Holley (3551), 4-4196; Carol Harrison (3552), 5-8243; Ami Peterson (3552), 5-9149; John McAuliffe (3562), 6-9806; Dennis Engi (6201), 4-4831; Charlotte Acken (8453), 8-234-3248; Pat Smith (8522), 8-234-2753; Gary Cochrell (9115), 6-7740.

•LP

(Continued from Page One)

Barrier Busters Tackle Bureaucracy

candidate issues that the Barrier Busters should address; more than 200 have been received so far.

But that doesn't mean every barrier has been identified. All Sandians are encouraged to participate in the process by identifying barriers and forwarding suggestions to the Barrier Buster team members (see list below).

Management Support

VPs Dan Hartley (6000) and Roger Hagengruber (9000) are team sponsors.

"I'm most impressed by the approach taken by the Barrier Busters," says Dan. "They are training themselves in quality management, assisting 'barrier owners' and championing their fixes."

"I consider Dan and myself as Barrier Busters for the Barrier Busters," says Roger. "Our role is to help them get their mission accomplished."

The team will use a consistent routine to identify and solve problems — a routine developed during Process Quality Management and Improvement (PQMI) training that all members received.

All suggested problems are put into a data base and prioritized according to their importance to Sandia's mission, potential cost savings, the number of people affected, probability of successful resolution, and how many similar comments are received.

A high-priority barrier is designated as an action item and assigned to a special Barrier Buster team that identifies the person who administers the process — the "process owner." The team meets with that person and works with him or her to implement a plan to remove the barrier, if possible. The team offers the process owner assistance in analyzing and improving the process through PQMI methods.

Resolutions will be published in the LAB NEWS.

Barrier busting in the Education and Training Department has already resulted in one change.

All Sandians are encouraged to participate in the process.

Division supervisors may now approve employee attendance at certain classes; previously, department managers had to approve attendance for Out-of-Hours, INCLAS, and INCOAT classes. Team member Linda McEwen (3522) worked with Dick Fairbanks, Supervisor of Individual Development Division 3521, on that one.

Written suggestions can be sent to any Barrier Buster member: Paul Rosenkoetter (110), Phil Dreike (1264), Rochelle Lari (2000), Tom Cannon

(2850), Janet Walerow (3162), Linda McEwen (3522), Larry Greher (4010), Estelle MacKenzie (5210), Elaine Gorham (6344), Shanna Cernosek (7000), Bill Alzheimer (7400), Betty Mowery (7541), Don Wagner (8532), and Dick Shaw (9213). Pamela Romero (3530) is the team's data base manager.

•JW

flexed Riback

Q. The Air Force has just raised the cost for using its gym to \$72/year — an increase of 100 percent in one year! With Sandia's emphasis on health, isn't it time to have a corporate facility? This facility may be our own gym or the Air Force gym, but Sandia needs to have some negotiated agreement with the AF regarding our rights (including costs).

Assuming that we will not have our own gym (actually all that most of us need are lockers and showers, which are not adequate at Sandia), is it possible for Sandia to pay the Air Force for the privilege of employees using its gym?

A. With a recent act of Congress, all Morale, Welfare, and Recreation (MWR) programs lost their appropriated funding. The loss was substantial for the Kirtland MWR group, which is now faced with making its programs completely self-supporting.

The use of MWR facilities by nonmilitary people is a result of military/civilian cooperation. However, Base facilities are completely "owned and operated" by the military, and military and MWR personnel set policy and fee structures. Civilian use of the facilities is strictly at the pleasure of the military, which has first priority to use its own facilities.

While it's unfortunate to see a 100-percent increase in the price of anything, a civilian using military facilities should weigh facility-access value. If he or she believes it's worth \$72, the choice can be made accordingly.

Ralph Bonner — 3500

Barrier Busters Team Charter

"Large and complex organizations will become bureaucratic. Policies, procedures, and rules that have their origin in legitimate requirements may over time become barriers to optimum performance by the individual and the organization. The process of eliminating unproductive or unnecessary administrative barriers can often be inefficient and viewed as unresponsive. We believe that special management attention to identifying and eliminating such barriers can be a strong and positive signal to employees about our commitment to an effi-

cient and adaptive organization and will help to foster open communication.

The Barrier Busters quality action team has the charter to identify unnecessary and inefficient policies, procedures, and rules, and to recommend or take action to eliminate or modify them. Suggestions regarding barriers in need of attention will be solicited from all levels of staff and management. The team will consist of representatives from these various levels with support and participation from the Sandia Management Council."

Lots of Air Filtration Uses

Albuquerque Firm to Manufacture Labs-Developed Foam

Sandia has signed its first exclusive licensing agreement since federal legislation making the process simpler became law last year.

The agreement provides for the payment of a royalty to Sandia for granting Perma Charge Corp. an exclusive license to make and sell a microcellular polymer foam developed at the Labs. Sandia holds the patent on the foam. Involved in its development were Jim Aubert, Ed Russick, and John Curro of Physical Properties of Polymers Div. 1813; Roger Clough of Chemistry of Organic Materials Div. 1811; Carlos Quintana of Fuel Science Div. 6211; and Montgomery Shaw, a past faculty sabbatical appointee from the University of Connecticut.

The size of the foam cells can be controlled better than those of conventional foams, so they are smaller and more evenly distributed. This makes for a low-density, porous material that is very uniform and has a high surface area.

Perma Charge is an Albuquerque company formed in late 1987 to manufacture electret materials for contamination-control applications. Principals of the company are Ioana McNamara, Jack Floegel, and Linda Witherspoon. McNamara is president, and Floegel is chief executive officer.

Permanent Electric Charge

Electret materials have a permanent electric charge and pull particles out of the air just as certain articles of polyester clothing attract dust and hair.

The company currently is making electret plastic films used to cover materials and equipment for protection against harmful particles or microorganisms. When the film cover becomes saturated, it is discarded.

Perma Charge officials plan to electret the Sandia foam and use it in HEPA (high efficiency particulate air) filters in hospitals, semiconductor and computer clean rooms, and other facilities requiring extremely particle-free environments. The license is for air filtration uses only, but the agreement gives Perma Charge an 18-month option to take a license on use of the foam also for liquid filtration.

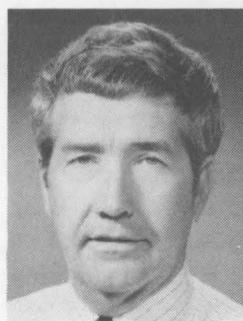
The agreement was signed June 19 by Gerry Yonas, Director of Laboratory Development 400, and Perma Charge President McNamara in the Tech Transfer Center conference room filled with the other Perma Charge officials and Sandians involved with either development of the foam or transfer of the product to industry.

Dan Arvizu, Manager of Technology Transfer and Industrial Relations Dept. 410, was one of those present. Gordon Graham and Dave Salazar of Dan's department conducted the negotiations that resulted in the agreement with Perma Charge.

"This is the third exclusive license agreement Sandia has signed, but it is the first since the National Competitiveness Technology Transfer Act of 1989 was enacted last fall," explains Dan.

"That new legislation gives tech transfer full status as a mission of DOE and streamlines the

Employee Death



Marvin Reichenbach of Mechanical Process Engineering Div. 7484 died June 8 after a long illness.

He was 51 years old.

Marvin was a member of the technical staff.

Survivors include his wife, son, and daughter.



GERRY YONAS (400) and Perma Charge President Ioana McNamara sign the agreement providing Perma Charge's exclusive right to manufacture a Sandia-developed foam in exchange for a royalty payment to the Labs.

procedures for setting up CRADAs [Cooperative Research and Development Agreements] between DOE laboratories and the private sector."

Makes Direct Negotiation Possible

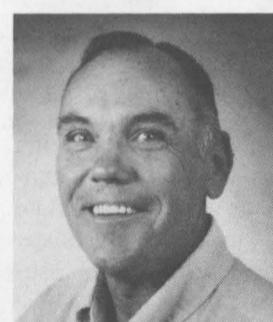
New provisions in the law, which is actually an amended version of the earlier tech transfer legislation, allow Sandia to negotiate directly with industry, dispose of intellectual property developed in a CRADA, and withhold publication of com-

mercially valuable information developed under a CRADA for up to five years.

Dan says these provisions provide the national labs with an important new authority. "It promises to improve our ability to respond to industry and to accelerate our emphasis on this important issue of national competitiveness. We anticipate the Perma Charge agreement will be the first of many such agreements we will sign," he says.

•AEtheridge(3161)

Recent Retirees



John Smatana
(1841)



Andy Lieber
(5290)

33 38

Take Note

Mike Cieslak (1833) was recently selected to chair the American Welding Society's Fellows Nominating Committee. The newly initiated AWS Fellow Award honors those who have made distinguished contributions that have enhanced the advancement of the science, technology, and application of joining in areas such as research and development, education, manufacturing, and design.

* * *

Friends and colleagues of retiring Sandian Andy Lieber are invited to drop by Bldg. 822, Conf. Rm. B, between 1:30 and 4:30 today to bid him farewell. Currently Manager of Systems Studies Dept. 5290, Andy has held a number of key positions during his 38-year Sandia career.

* * *

AISE (American Intercultural Student Exchange) is seeking host families for high-school foreign exchange students arriving in the fall. Students will stay for a full school year. For more information, call 1-800-SIBLING or Mary Ann Vittitoe on 299-9298.

* * *

Retiring and not shown in LAB NEWS photos: James Young (2541), Natalie Vytlacil (2613), Roberta Voelker (3151), Nancy Barela (3437), Howard Tessler (5214), Gerald Hinman (7411), Andrew Sayers (7526), and Jackie McQueen (9330).

Congratulations

To Mikal Ann Smoker and Jeff Kawola (1811), married in Albuquerque, May 5.

To Mary Abromitis and Patrick Musinski (2858), married in Shamokin, Pa., May 26.

To Cindy and Marcos (7818) Martinez, a son, Marcos III, May 27.

To Tammy and Russell (3426) Mickey, twins, Colton Scott and Brandon Lee, May 28.

To Janet and Paul (6312) Kaplan, a son, Jonathan Morris, May 29.

To Carmen and Bob (2857) Dedig, a son, Shane Gerard, June 6.



FOUR SANDIANS recently received Certificates of Appreciation from the US Nuclear Command and Control System Support Staff (NSS) for their support of projects related to NSS operations policy and a sabotage vulnerability analysis plan. Everett Beckner (5000) presented the certificates to Ben Bader (5101, seated) and (standing, from left) Dick Burcham, David Jeppesen, and Bob Bradley (all 5128).

(Continued from Page One)

Test Chips Give Inside Information

"An assembly test chip can identify what's going on in the chip's environment, or inside the packaging, to cause failure," says Jim Sweet (2134), the chip's designer. "Frequently, with an operational chip, such as a microprocessor, it's difficult to say what caused the failure. It just stops."

For instance, corrosion of aluminum circuit lines can mean death for a chip. Sandia's first-generation assembly test chip, already in use, contains sensors that can detect corrosion, help identify the chemical reactions that are responsible, and provide information about the rate of corrosion. This chip also has conductor lines around its perimeter that can detect edge and surface damage.

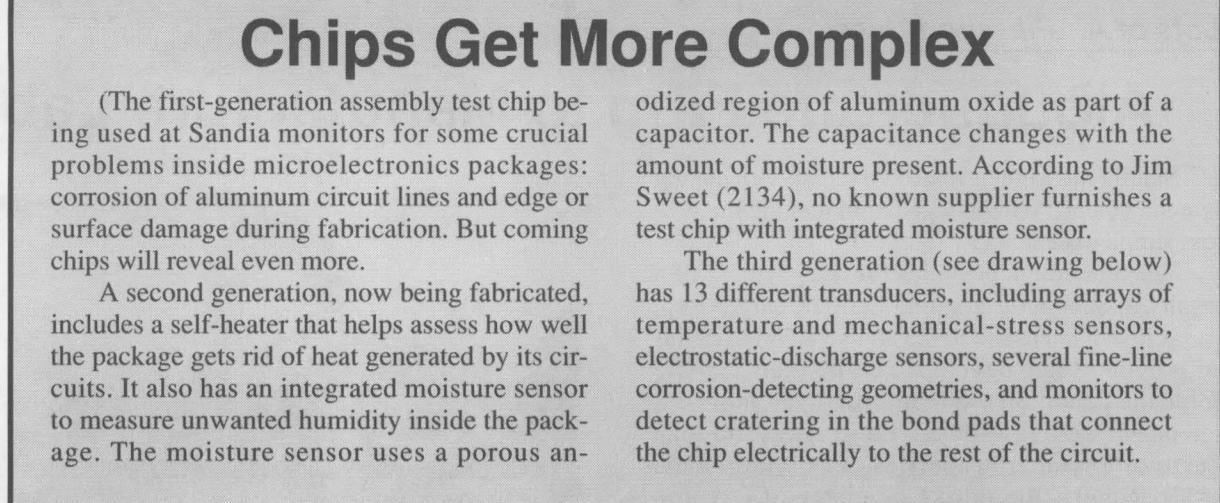
A second-generation chip is in the final stages of fabrication, and design is being completed for a third. Each succeeding generation can sense more conditions than the previous (see "Chips Get More Complex"). Jim gives credit for the development

Assembly test chips could help check the "state of health" of an assembly line.

effort to Melanie Tuck (2134), who worked with Process Engineering and Prototyping Div. 2131 on wafer fabrication; Dave Peterson (2134), who developed test systems and measurement techniques; and Dave Renninger (2115), who did the chip layout.

Monitors Product or Process

An assembly test chip can be used to monitor circuits in the field for possible failure, or to monitor or evaluate the assembly and packaging process itself. "In a weapon or other system," says Jim, "you could put a test chip on one of the circuit boards and access the sensors by an external connector. You might use a chip with a hydrogen sensor and a moisture sensor, among others, because common breakdowns of packaging involve hydrogen emission or an increase in moisture levels, or both. And of course you'd be watching for other



things, too, such as corrosion.

"Another type of use," continues Jim, "would be to check the 'state of health' of an assembly line. You'd send assembly test chips through the same processes as other chips, then make measurements to decide how well the process is working. For instance, electrostatic discharge, or ESD, can give you a minor zap when you walk across a carpet and touch a doorknob, but it's a major chip killer. An ESD sensor like the one being included in our third-generation chip could show whether workers on an assembly line were properly grounded and handled the chips properly."

Used this way, assembly test chips could help assess the quality of semiconductor manufacturing. Semiconductor developers might give potential packagers a set of chips, then evaluate how the chips fared during assembly and packaging. Or a production facility could be asked to process a thousand assembly test chips annually along with the production chips. This could provide a non-invasive, quantitative measurement of handling damage, corrosive residue, moisture, and similar problems.

Pushing in New Direction

By taking seriously the design of an evolving series of test chips, Sandia is trying to move manufacturing technology in a new direction. The largest US microelectronics companies have made and used assembly test chips, but these have usually had only one or two types of sensors and have been used in the development of a single product. Demand has been too small for a company to de-

Chips Get More Complex

(The first-generation assembly test chip being used at Sandia monitors for some crucial problems inside microelectronics packages: corrosion of aluminum circuit lines and edge or surface damage during fabrication. But coming chips will reveal even more.)

A second generation, now being fabricated, includes a self-heater that helps assess how well the package gets rid of heat generated by its circuits. It also has an integrated moisture sensor to measure unwanted humidity inside the package. The moisture sensor uses a porous an-

odized region of aluminum oxide as part of a capacitor. The capacitance changes with the amount of moisture present. According to Jim Sweet (2134), no known supplier furnishes a test chip with integrated moisture sensor.

The third generation (see drawing below) has 13 different transducers, including arrays of temperature and mechanical-stress sensors, electrostatic-discharge sensors, several fine-line corrosion-detecting geometries, and monitors to detect cratering in the bond pads that connect the chip electrically to the rest of the circuit.

velop and refine a multipurpose test chip.

"If somebody wants a million chips," says Jim, "a commercial supplier will come into the market and make them. If somebody wants 10,000 to 50,000, the economics of integrated circuits make such quantities commercially unattractive. And if somebody wants only a hundred chips, no supplier will make them unless the customer is willing to pay a steep price for each one."

Sandia's efforts, however, could encourage wider manufacture and use of assembly test chips. Some of the development of Sandia's chips was

Sandia is trying to move manufacturing technology in a new direction.

funded internally by the technology maturation program, and one goal of the development work is to transfer test-chip and sensor technologies to American industry.

"The electronic design basis of the chip will be made available to American companies that want to manufacture the chips or the sensor components," says Dave. "We can provide sample quantities on an as-available basis, and have already done so in a few cases." Details are still being worked out for responding to requests for larger quantities.

Already, there's increasing interest in the assembly test chips, says Jim. For instance, a consortium of semiconductor manufacturers is teaming with a university in hope of using plastic to replace the expensive ceramic packages that hermetically seal microelectronics in military systems. That could pay off with big savings, Jim points out, noting that an ordinary personal computer would, if it used ceramic-packaged instead of plastic-packaged chips, cost about \$50,000. But plastic doesn't keep out water as well as ceramic packages do, so development of acceptable plastic packages would rely on assembly test chips for evaluation.

Although the latest chips have more sensors than any test chip known to have been developed previously, the design is based on established CMOS (complementary metal-oxide-semiconductor) technology used in many companies' integrated-circuit facilities. CMOS circuits have the advantage of allowing fabrication of precise, highly responsive sensors. The result, Sandia's developers hope, will be both good performance and lowered cost, so that the assembly test chip can become a widely used tool in the American microelectronics industry.

●CS/KFrazier(3161)

Sympathy

To Evaristo Gutierrez (7818) on the death of his father-in-law in Albuquerque, May 31.

To Ron Hartwig (5166) on the death of his mother in Houston, June 5.

To Dick Eno (7525) on the death of his mother in Albuquerque, June 12.

To George Donaldson (7525) on the death of his daughter-in-law in Texas, June 12.

To Steve Lambert (6233) on the death of his mother in California, June 13.

THIRD-GENERATION assembly test chip, now in final design, is about 1/4 inch on a side and has 13 different sensors to detect whether it has been damaged during or after packaging.

Recent Patents To Sandians

Marty Carr (1822) and Al Romig (1830): Normal Incidence X-Ray Mirror for Chemical Microanalysis.

John Shelnutt (6211): Process for Light-Driven Hydrocarbon Oxidation at Ambient Temperatures.

Carol Ashley (1846) and Scott Reed (7476): Sol-Gel Anti-reflective Coating on Plastics.

Arthur Mullendore (former Sandian): Formation of Amorphous Metal Alloys by Chemical Vapor Deposition.

Bob Dosch (DMTS, 6211) and Howard Stephens (6212): Hydrous Oxide Ion-Exchange Compound Catalysts.

Holly Dewhurst (3211): Inertial Impaction Air Sampling Device.



flexed Riback

Q. I applaud Al Narath for his commitment to the new quality initiative. One method of achieving quality is communication; it stands to reason that the more input available, the more qualitative the output. Sandia has an untapped input — its employees. We are all professionals trying to achieve a common goal. Subordinates are evaluated by management. Since communication is a two-way street, why is this not reciprocal?

A. Sandia is committed to improving communication Lab-wide. Multidirectional communication is part of that commitment.

Al Narath used upward feedback as a mechanism to improve the quality of working relationships in the vice-presidency he led at Bell Laboratories. An Upward Feedback Committee, chaired by myself, has been developing a program for Sandia over the past several months. Phase I of this program will begin this summer [see article in this issue] and will involve upward

feedback on Large Staff (directors and above). Since skip-level feedback is planned, this phase will involve feedback from division supervisors and department managers.

Phase II, involving upward feedback on section supervisors through department managers, will soon follow. Phase II implementation will involve employees in all non-supervisory classifications.

Ralph Bonner — 3500

Congratulations

To Gail and Ronald (2341) Simon, a son, Samuel Phillip, June 8.

To Jackie and Mark (2831) Geerts, a daughter, Ashley Theresa, June 12.

To Elaine Howard (9310) and Lloyd Brooks, married in Bosque Farms, June 15.

UNCLASSIFIED ADVERTISEMENTS • UNCLASSIFIED ADVERTISEMENTS • UNCLASSIFIED ADVERTISEMENTS • UNCLASSIFIED ADVERTISEMENTS

Deadline: Friday noon before week of publication unless changed by holiday. Mail to Div. 3162.

Ad Rules

1. Limit 20 words, including last name and home phone.
2. Include organization and full name with each ad submission.
3. Submit each ad in writing. No phone-ins.
4. Use 8½ by 11-inch paper.
5. Use separate sheet for each ad category.
6. Type or print ads legibly; use only accepted abbreviations.
7. One ad per category per issue.
8. No more than two insertions of same "for sale" or "wanted" item.
9. No "For Rent" ads except for employees on temporary assignment.
10. No commercial ads.
11. For active and retired Sandians and DOE employees.
12. Housing listed for sale is available for occupancy without regard to race, creed, color, or national origin.

MISCELLANEOUS

WASHER AND DRYER, Speed Queen, heavy-duty, 4 yrs. old, white, stainless-steel construction, \$350 OBO. Laguna, 298-1732.

ROTARY TILLER, Montgomery Ward, chain drive, 5-hp, \$250. Christensen, 884-8249.

LEADING EDGE COMPUTER, Model D, AT-compatible, 512 RAM, 30-Megabyte hard disk, monochrome monitor, best offer. Clarke, 292-1330.

AQUARIUM, 55-gal., w/2 air pumps, heater, cinder-block stand, \$200 value, sell for \$125. Cropp, 296-1877.

BISCHON PUPPY, male, AKC-registered, 8 wks. old, weighs 3 lbs. Frytz, 296-3813.

KNABE PIANO, 40" classic console, mahogany finish, needlepoint-covered bench, original ivories, appraised at \$2495, sell for \$2000. Kaiser, 828-1660.

RAINBOW VACUUM CLEANER, w/attachments, \$300. Smith, 888-7928.

UMBRELLA TENT, heavy canvas; vacuum cleaner; books; Russel Wright pottery, 8 place settings, extra serving pieces. Southwick, 281-3782.

REFRIGERATOR, 19 cu. ft., white, \$100; jogging trampoline, \$8; GE scrubber/polisher, \$25; '81 Oldsmobile Omega manual, \$5. Bentz, 299-3448.

HONEYCUIT VIOLA, 15-1/2", new strings, complete checkup, case, original owner, \$2000. Judd, 294-5347.

EPSON MX80FT PRINTER, manual, ribbons, \$125; Prestolite torch, for silver work, no tank, \$40 OBO. Champion, 299-0163.

FOUR WHEELS, from '81 Toyota pick-

up, 14x6" size, 5-hole, w/hubcaps & lug nuts, \$50. Harding, 291-9449.

COMPUTER, Texas Instruments

TI99/4A, manuals, \$35; Panasonic

B&W TV, 11" screen, \$35. Slutts,

255-3693 evenings.

STEREO EQUIPMENT: Ampex tape deck, Fairchild turntable, Fisher receiver/amplifier, 2 maple-finished speaker enclosures, 200 recorded tapes, make offer. Boyes, 299-2569.

LOWREY CITATION THEATER ORGAN, Leslie speaker, solid mahogany, \$500 OBO. Lunsford, 275-0158.

QUEEN-SIZE WALNUT HEADBOARD, electric coffee maker, credenza-style stereo. Prevender, 296-8586.

APPLE IIc, additional 5.25 drive, color monitor, mouse, joystick, \$450; ImageWriter II printer, \$250. Josephson, 299-9495 after 5.

PEAVEY GUITAR AMPLIFIER, Backstage Plus model, 100 watts, \$100. Petrino, 265-1826.

CRAFTSMAN 10" RADIAL ARM SAW, \$150 OBO; Craftsman 5" miter box, \$75 OBO; miscellaneous aluminum double-pane windows, \$250. Caton, 281-9420.

QUEEN-SIZE WATER BED, handmade headboard frame, pedestal drawers, waveless mattress, \$350. Kovacic, 256-9867.

RCA 25" COLOR TV, remote, \$185; sofa, sectional sleeper, 2 ends recline, oatmeal color, \$400 firm. Smith, 275-8185 after 5.

LEATHER COUCH, 84", \$750; 2 end tables, 1 coffee table, glass tops, \$350/set; octagonal glass-top pedestal kitchenette set, Chrome Craft, \$500. Mitchell, 299-5144 after 3.

CHILD'S CANOPY BED, \$60; queen-size water bed mattress; 11-lb. bowling ball, bag, shoes. Wilde, 281-4511.

ROUND DRAPERY RODS, wood, three 3'8", one 8'2"; ivory drapes; round metal rod, 6'; all complete, brackets, rings. Kindschi, 256-0531.

FOOSBALL TABLE, Italian-made, 24" x 40" playing surface, \$50. Gillen, 298-2282.

FISHING EQUIPMENT: trout lines, tackle, poles, hooks, minnow baskets, bass lures, more. Kindschi, 256-0531.

TROUBADOUR HARP, made by Lyon and Healy, 33 strings, \$950 OBO. Sundberg, 281-1199.

WURLITZER CONSOLE PIANO, \$850. Stewart, 293-3959.

TRS80 MOD 4D COMPUTER, w/TRSDOS, CP/M OSs, Turbo PASCAL, \$500 OBO; 2-channel radio-control system, \$50 OBO; Sears engine analyzer, \$30 OBO. Hawthorne, 471-0448.

TWO GOSLINGS, free to good home. Bauer, 266-8480.

EXERCYCLE, \$25. Fisher, 881-8072.

AIRLINE B&W TV, 19.5", \$50; Hoover

vacuum cleaner, \$30. Pinkerton, 255-2505.

APPLE IIe COMPUTER, w/printer, \$900 OBO; student teak desk, \$40. Phillips, 842-5250.

SINGLE CAPTAIN'S BED and matching chest, white w/yellow trim, \$150. Koski, 822-1122.

BEDROOM FURNITURE, Broyhill, yellow French Provencal, corner desk, 2 bachelor's chests, hutch, nightstand, \$250. Robertson, 299-7561.

FULL-SIZED BEDROOM SET, Thomasville, oak, dresser, 2 nightstands, \$500; full-size sleeper sofa, Stratford cotton, modern floral print, \$250. Cook, 888-2928.

ESTATE SALE: furniture, small appliances, clothing, fabric, needlework kits, vacuum cleaner, metal cabinets, evaporative cooler parts, June 30, 10 a.m. to 4 p.m. Joseph, 299-6989.

SEARS SWING SET: slide, 2 swings, slider, seat swing, \$75. Claussen, 293-9704.

BALDWIN FANFARE ORGAN, w/bench, books, \$1200; upright piano, tuned, w/bench, \$325; RV awning, AE 8000, 11', \$300. Randolph, 299-2057.

SEARS REFRIGERATOR/FREEZER, 19 cu. ft., w/ice maker, water dispenser, \$350; Whirlpool electric range, \$100. Johnston, 299-1830.

GARAGE SALE: multi-family, misc. household items, collectibles, books, tools, July 6, 7, 8, 1228 Zena Lona NE (near Juan Tabo & Constitution). Yarnall, 256-3800.

ROWING MACHINE, Precor 6.2, w/digital readout, \$250; file cabinet, Durable, 4-dr., \$35. Haushalter, 821-4138.

TIRES, 13", \$2; dishwasher, \$25; recliners, \$5; bicycle basket, \$2.50; derby frame, \$4. Foster, 299-6240 after 6.

GOLF BALLS, new, in original containers, Titleist DT, Penacle, Topflight XL, \$9.75/doz. Stang, 256-7793.

EXERCYCLE, DP brand, speedometer and odometer, book rack, 86 miles, \$30. Hawkinson, 281-1281.

GARAGE SALE: kids' clothes (0-4), adult clothes, boots, shoes, bird cage, pet transporter, speakers, June 30-July 1, 7833 Vista del Arroyo NE. Mead, 294-2298.

'77 OLDS. DELTA 88, V-8 engine, white/tan interior, AM/FM stereo cassette, 90K miles, \$800 OBO. Benham, 881-2593.

'78 F-150 TRUCK, 4-WD, new engine, long bed, \$3500. Nelson, 881-0148.

'84 OLDS. 88, 4-dr., 46K miles, AC, cruise, AM/FM tape, all power options, one owner, \$4900. Champion, 299-0163.

'74 VW CAMPER, 116K miles, \$450; '77 Suzuki GS400, 9.5K miles, \$400; Gitane Jr. sport bicycle, \$75. Parsons, 298-7363.

'81 SUZUKI GS550L MOTORCYCLE, 6.8K miles, w/extras. Heise, 821-2869.

'68 PONTIAC FIREBIRD 400, new paint & interior, \$4500. Prevender, 296-8586.

BMX BIKE, Team Murray, 20", \$30. Diegle, 294-5565.

10-SPD. BICYCLES boy's & girl's models, \$50 & \$70. Kramer, 294-0488.

SCHWINN PRELUDE, 25-1/2" frame, '87 model, \$250. Kovacic, 256-9867.

10-SPD. BICYCLE, \$25. Fisher, 881-8072.

'88 TOYOTA 4x4 X-TRA CAB DELUXE, 5-spd., cruise, AC, AM/FM cassette, 34K miles, \$8400. Lifke, 821-5542.

'82 JEEP CJ-7, 258-CID 6-cyl. engine, \$4950. Rutledge, 266-5481.

BICYCLES: Nishiki 12-spd., 23" frame, \$150; Takara 12-spd., 19" frame, \$125. Kimberly, 293-5835.

REPOS: '89 Chev. Geo; '86 Ford F-150 pickup; we reserve the right to refuse all bids; subject to prior sale. Sandia Lab FCU, 293-0500.

'80 CHEV. CITATION, 2.8L V-6, 4-dr., AC, PS, PB, 4-spd., AM/FM cassette, \$950 OBO. Wicz, 296-4496.

'74 GMC 1/2-TON PICKUP, 6-cyl., 3-spd., 78K miles, \$1700 OBO. Schaub, 865-9581.

PANASONIC 25" 12-SPD. BICYCLE, front and rear bags, \$75. DeReu, 275-2336.

MOUNTAIN BIKE, \$125. Davis, 294-1048.

'84 DODGE MAXIVAN, 62K miles, front & rear AC, AT, \$8150. Sterk, 296-3453.

HONDA TWINSTAR MOTORCYCLE, 185cc twin, 6K miles, \$400. Ewing, 268-6920.

'89 TOYOTA MINIVAN, AC, PS, PB, AT, \$13,000. Padilla, 899-1913.

'81 VW CAMPER VAN, refrigerator, stove, water, pop-up top, 43.5K miles, \$4000. Depoy, 298-8308.

'84 CHEV. CAMARO, 305 V-8, AT, AC, AM/FM cassette, cruise, new tires, PS, PB, 75K miles, \$3900. Habbit, 293-7216.

'73 AMC AMX, 360, AT, PS, PB, \$1750. Gorman, 292-7119 or 255-4431.

'83 TOYOTA CELICA GT, 3-dr., 4-cyl., EFI, AT, OD, PS, PB, AC, AM/FM stereo tape w/clock, cruise, 35.8K miles, \$5150. Stang, 256-7793.

'87 ACURA INTEGRA, LS series, 5-dr., AT, loaded. Bronkema, 821-2119.

WOMAN'S COLUMBIA BICYCLE,

10-spd., brown, \$30. Hawkinson, 281-1281.

REAL ESTATE

3-BDR. HOME, 2 baths, FP, paneling, garage, sprinklers, dishwasher, refrigerator, washer, dryer, Central & Juan Tabo area, \$58,000. Coulter, 275-2183.

3 OR 4-BDR. HOME, newly remodeled, double garage, dishwasher,

Coronado Club Activities**Celebrate Your Independence Next Wednesday on the Patio**

ALL GOOD FLAG-WAVERS get together next Wednesday, July 4, at the pool/patio area for the most patriotic of parties — an old-fashioned Independence Day celebration from 11 a.m. to 6 p.m. The Dukes of Albuquerque Band starts things off by playing stirring songs from 11:30 to 2:30 to get you in the mood. While you're enjoying the music, grab a plateful of picnic food from the buffet featuring goodies like hamburgers, hot dogs, BBQ beef, and potato and macaroni salads. Enjoy a swim in the new pool, organize a volleyball or basketball game, throw some horseshoes, or just take it easy. Festivities are free for Club members, \$3 for guests.

START THE WEEKEND RIGHT tonight, June 29, with dinner and dancing. The elegant entree selection includes prime rib (\$7.95), lobster tail (\$13.95), filet mignon (\$8.95), and stuffed cod (\$6.95). Eating light? Try the soup and salad bar (\$3.95/all you can eat, \$1.50/one trip). Afterward, enjoy variety dancing music from a new band

called Pyramid from 8 p.m. to midnight. Dinner reservations recommended (265-6791).

IF YOU'RE BONKERS FOR BINGO, you have more opportunities than ever to try your luck in July. Budget Bingo makes its debut, with gaming scheduled every Tuesday night, beginning July 10. All sessions start at 7 p.m. and have 14 games, including two \$250 jackpot specials and the Fortune-Wheel game. A \$5 package of cards includes every game except Last-Chance Bingo. Card sales begin at 5:30, and reasonably priced food is available throughout the evening. Regular bingo continues on Thursdays, with the early-bird game slated for 6:45 p.m.; cards go on sale at 5:30.

THOSE GOOD OLE POOR BOYS FROM ISLETA prance into town Friday night, July 6, to belt out their sagebrush specialties from 8 p.m. to midnight. Beforehand, enjoy some great chow: prime rib, poached halibut, fried shrimp (all \$7.95), or filet mignon (\$8.95). Dinner-reservation

holders who wear cowboy hats get a little something extra thrown in — a free well-drink ticket.

IF YOU'RE CLEANING OUT THE GARAGE, and don't know what to do with all that stuff, take heart. Your junk can become somebody else's treasure at the C-Club flea market, scheduled Sunday, July 15, from 9 a.m. to 2 p.m. in the front parking lot. Call the office to reserve a selling space for just \$4. Don't worry about cooking that day; in between sales, grab a bite to eat at the food line featuring specials for hungry vendors — burgers, Polish hot dogs, chile dogs, soft drinks, and more. Born-to-shop browsers are also encouraged to show up.

THE BRUNCH BUNCH swings back into action on Sunday, July 8, from 10 a.m. to 2 p.m. Discount prices continue next month; all that fabulous food goes for just \$5.95/adults and \$2.50/children under 12. Sunday brunches are popular events, so make your reservation early.

Events Calendar

Geometric Form in the Pursuit of a Unifying Principle"; 9 a.m.-4 p.m. Tues.-Fri., 5-9 p.m. Tues. evening; UNM's Jonson Gallery, 277-4967.

June 29-Oct. 14 — "Georgia O'Keeffe and the Stieglitz Circle," exhibition examining the group of artists (including O'Keeffe) who were affiliated with Alfred Stieglitz, the photographer, gallery owner, and champion of early 20th Century avant-garde art; 9 a.m.-4 p.m. Tues.-Fri. (5-9 p.m. Tues. evening), 1-4 p.m. Sun.; Upper Gallery, UNM Art Museum, 277-4001.

June 30 — Summerfest '90: Italian Night, ethnic food, arts & crafts, dances; 5-10 p.m., free, Civic Plaza, 768-3490.

June 30-July 1 — 8th Annual Arts and Crafts Fair: Native American artists, dancers, entertainment; 10 a.m.-4 p.m., free, Indian Pueblo Cultural Center, 843-7270.

July 2 — "Meditation and Cultural Survival Through Humor in the Puebloan World," lecture by Allison Freese; 10 a.m., Indian Pueblo Cultural Center, 843-7270.

July 3 — Annual 4th of July fireworks display, sponsored by American Legion Post #13; gates open 5:30 p.m., fireworks at 9 p.m.; UNM Football Stadium, 294-8452.

July 3 — Annual 4th of July fireworks display, sponsored by the Old Town Optimist Club; gates open

5:30 p.m., fireworks at 9 p.m.; New Mexico State Fairgrounds, 242-3232.

July 4 — Spirit '90: entertainment, activities, food, New Mexico Symphony Orchestra, fireworks, sponsored by KAFB and KGGM TV-13; gates open 3 p.m.; enter KAFB through Carlisle and Truman gates, 243-2285.

July 4 — Nambe Waterfall Ceremonial: Bow and Arrow, Buffalo, Corn, Harvest, and Snake dances; call for time, Nambe Pueblo, 843-7270.

July 6-8 — Festival Flamenco '90: concert of flamenco dance, music, and song; 8 p.m., 2 p.m. Sun.; Rodey Theatre, 277-4402.

July 6-8 — Albuquerque Bestfest: music, dance, arts, crafts, vintage cars, hot-air balloons, food, contests, entertainment, sponsored by the Albuquerque Convention & Visitors Bureau; 5-9 p.m. Fri., 11 a.m.-6 p.m. Sat. & Sun.; New Mexico State Fairgrounds, free, 243-3696.

July 7 — Summerfest '90: Chinese Moon Festival, ethnic food, arts & crafts, dances; 5-10 p.m., free, Civic Plaza, 768-3490.

July 8 — Arts in the Parks: "Tardeadas" (afternoon fiesta), performers include Stefani Sullivan (*Angel Baby*), Los Tapatios de Frances Bustamante; 1-5 p.m., Old Town Plaza, free, 768-3490.

Fun & Games

Aerobics — Don't sweat the summer heat alone. Join the TLC summer aerobics class in the Area I Cafeteria (Bldg. 861) Monday through Friday from 4:45 to 6 p.m. Tuesday classes emphasize strength, stretch, and relaxation. Cost is \$36 for 12 weeks. Classes are ongoing and may be joined at any time. For information, contact Anna Foster at TLC on 6-5880.

Sailing — For the eighth year in a row, Bill Horton (DOE, ret.) is leading hands-on Caribbean sailing adventures for novice and experienced sailors. He's sailing three separate 10-day cruises on a 45-ft. chartered yacht in the US and British Virgin Islands this November. Bill can take four passengers on each cruise. These are not money-making ventures — Bill charges enough to meet expenses. For information, call him on 883-7504.

Flying — The initiation fee will be waived for individuals joining the Kirtland Aero Club in July. Membership is open to Sandia and DOE employees and dependents, and contractors. Stop by club headquarters in KAFB Hangar 333 or visit the Aero Club booth during KAFB's July 4 celebration, Spirit '90. Contact club manager Gloria Hinshaw on 4-0884 for information.



WASHINGTON TRIP was part of the prize for Jeff Johnson (3435, right), 1989 DOE Security Inspector of the Year, who visited with NM Congressman Steve Schiff (second from right). Accompanying Jeff and also seen here were Bob Kelly, Manager of Safeguards and Security Services Dept. 3430, and Jeff's fiancée, Beth Grafa. Jeff also visited with DOE Under Secretary John Tuck and Acting Deputy Assistant for Security Affairs William Barker. Although Jeff won the competition last summer, the trip was timed to see Washington at its springtime best. This August, Sandia will enter a nine-person team in the 1990 Small Arms Training and Security Inspector of the Year competitions; Capt. Harold Garcia (3434) is the team coach and captain.